CLAIMS

What is claimed is:

1. An optical switching component comprising:

   a stator;

   a rotor pivotally coupled to the stator and including a top surface;

   a first piezoelectric actuator coupled to the stator and the rotor and configured to pivot the rotor relative to the stator when actuated.

2. The optical switching component of claim 1 further comprising an optically reflective coating formed on the top surface.

3. The optical switching component of claim 2 further comprising a seed layer between the optically reflective coating and the top surface.

4. The optical switching component of claim 1 further comprising a second piezoelectric actuator, the first and second actuators configured to cooperatively pivot the rotor relative to the stator when actuated.

5. The optical switching component of claim 4 wherein the first and second piezoelectric actuators connect opposite ends of the rotor to the stator.

6. The optical switching component of claim 1 including four piezoelectric actuators, wherein two of the four piezoelectric actuators are configured to pivot the rotor

relative to the stator around a first axis and the other two piezoelectric actuators are configured to pivot the rotor relative to the stator around a second axis.

7. The optical switching component of claim 1 wherein the rotor further includes a first side and the stator includes a first limiting side, the two sides opposing one another to define a gap therebetween, the gap serving to define the range of travel of the rotor in a direction towards the first limiting side.

8. The optical switching component of claim 1 further comprising a controller in communication with the piezoelectric actuator and capable of applying a voltage thereto.

9. The optical switching component of claim 8 wherein the controller is configured to apply the voltage to the piezoelectric actuator to orient the top surface such that an angle of incidence of an emitted beam from a first port is substantially equal to an angle of reflectance of a reflected beam received by a second port in response to an instruction to switch the beam.

10. The optical switching component of claim 9 further comprising a detector in communication with the controller and capable of determining a signal strength of the reflected beam at the second port.

11. The optical switching component of claim 10 wherein the controller is capable of optimizing the signal strength of the reflected beam at the second port based on the communication from the detector.

12. An optical switching device comprising:

an optical switching component including;

a stator,

a rotor pivotally coupled to the stator and including a top surface,

a first piezoelectric actuator coupled to the stator and the rotor and configured to pivot the rotor relative to the stator when actuated, and

a controller in communication with the first piezoelectric actuator and capable of applying a voltage thereto;

an emitter port defining a first line within a plane and fixed proximate to the optical switching component such that the first line intersects the top surface at about a center thereof to define an angle of incidence between the first line and the top surface;

a receiver port defining a second line within the plane and fixed proximate to the optical switching component such that the second line intersects the top surface at about a center thereof to define an angle of reflectance between the second line and the top surface.

13. The optical switching device of claim 12 further comprising an optically reflective coating formed on the top surface.

14. The optical switching device of claim 13 further comprising a seed layer between the optically reflective coating and the top surface.

15. The optical switching device of claim 12 further comprising a second piezoelectric actuator, the first and second actuators configured to cooperatively pivot the rotor relative to the stator when actuated.

16. The optical switching device of claim 15 wherein the first and second actuators connect opposite ends of the rotor to the stator.

17. The optical switching device of claim 12 wherein the optical switching component includes four piezoelectric actuators, two of the four piezoelectric actuators being configured to pivot the rotor relative to the stator around a first axis and the other two piezoelectric actuators being configured to pivot the rotor relative to the stator around a second axis.

18. The optical switching device of claim 12 wherein the rotor further includes a first side and the stator includes a first limiting side, the two sides opposing one another to define a gap therebetween, the gap serving to define the range of travel of the rotor in a direction towards the first limiting side.

19. The optical switching device of claim 12 wherein the controller is configured to apply the voltage to the piezoelectric actuator to orient the top surface such that the angle of incidence is substantially equal to the angle of reflectance in response to an instruction to switch the beam.

20. The optical switching device of claim 19 further comprising a detector in communication with the controller and capable of determining a signal strength of the reflected beam at the second port.

21. The optical switching device of claim 20 wherein the controller is capable of optimizing the signal strength of the reflected beam at the second port based on the communication from the detector.

22. An optical switching device comprising:

a plurality of optical switching components arranged in an array, each component including;

a stator,

a rotor pivotally coupled to the stator and including a top surface,

a first piezoelectric actuator coupled to the stator and the rotor and configured to pivot the rotor relative to the stator when actuated, and

a controller in communication with the piezoelectric actuator and capable of applying a voltage thereto;

a plurality of emitter ports, each emitter port being associated with one of the plurality of optical switching components, each emitter port defining a first line within a plane and fixed proximate to its associated optical switching component such that the first line intersects the top surface at about a center thereof to define an angle of incidence between the first line and the top surface;

at least one receiver port associated with each optical switching component, each receiver port defining a second line within the plane and fixed proximate to its associated optical switching component such that the second line intersects the top surface at about a center thereof to define an angle of reflectance between the second line and the top surface.

23. The optical switching device of claim 22 further comprising an optically reflective coating formed on the top surface of each rotor of each of the plurality of the plurality of optical switching components.

24. The optical switching device of claim 23 further comprising a seed layer between each optically reflective coating and each top surface.

25. The optical switching device of claim 22 wherein each of the plurality of optical switching devices further includes a second piezoelectric actuator, the first and second actuators configured to cooperatively pivot each rotor relative to the stator when actuated.

26. The optical switching device of claim 25 wherein the first and second piezoelectric actuators connect opposite ends of the rotor to the stator.

27. The optical switching device of claim 22 wherein each optical switching component includes four piezoelectric actuators, two of the four piezoelectric actuators of each optical switching component being configured to pivot the rotor relative to the stator around a first axis and the other two piezoelectric actuators being configured to pivot the rotor relative to the stator around a second axis.

28. The optical switching device of claim 22 wherein at least one rotor further includes a first side and the stator includes a corresponding first limiting side, the two sides

opposing one another to define a gap therebetween, the gap serving to define the range of travel of the at least one rotor in a direction towards the first limiting side of the stator.

29. The optical switching device of claim 22 wherein each controller is configured to apply the voltage to the piezoelectric actuator to orient the top surface such that the angle of incidence is substantially equal to the angle of reflectance in response to an instruction to switch the beam.

30. The optical switching device of claim 29 further comprising a detector in communication with each controller and capable of determining a signal strength of the reflected beam at the second port.

31. The optical switching device of claim 30 wherein each controller is capable of optimizing the signal strength of the reflected beam at the second port based on the communication from the detector.

32. A method for switching an optical signal comprising:

providing an optical switching device including an optical switching component including

a stator,

a rotor pivotally coupled to the stator and including a top surface,

a first piezoelectric actuator coupled to the stator and the rotor and configured to pivot the rotor relative to the stator when actuated,

a controller in communication with the piezoelectric actuator and capable of applying a voltage thereto,

an emitter port defining a first line within a plane and fixed proximate to the optical switching component such that the first line intersects the top surface at about a center thereof to define an angle of incidence between the first line and the top surface,

a receiver port defining a second line within the plane and fixed proximate to the optical switching component such that the second line intersects the top surface at about a center thereof to define an angle of reflectance between the second line and the top surface;

receiving an instruction at the controller;

applying a voltage to the first piezoelectric actuator to orient the top surface such that the angle of incidence is substantially equal to the angle of reflectance; and

emitting a beam from the emitter port such that it travels substantially along the first line, reflects off the top surface, and is received by the receiver port.

33. The method for switching an optical signal of claim 32 further comprising an optically reflective coating formed on the top surface of the rotor.

34. The method for switching an optical signal of claim 33 further comprising a seed layer between the optically reflective coating and the top surface.

35. The method for switching an optical signal of claim 32 wherein the optical switching device further includes a second piezoelectric actuator, the first and second actuators configured to cooperatively pivot the rotor relative to the stator when actuated.

36. The method for switching an optical signal of claim 35 wherein the first and second actuators connect opposite ends of the rotor to the stator.

37. The method for switching an optical signal of claim 32 wherein the optical switching component includes four piezoelectric actuators, two of the four piezoelectric actuators being configured to pivot the rotor relative to the stator around a first axis and the other two piezoelectric actuators being configured to pivot the rotor relative to the stator around a second axis.

38. The method for switching an optical signal of claim 32 wherein the rotor further includes a first side and the stator includes a first limiting side, the two sides

opposing one another to define a gap therebetween, the gap serving to define the range of travel of the rotor in a direction towards the first limiting side.

39. The method for switching an optical signal of claim 32 wherein the controller is configured to apply the voltage to the piezoelectric actuator to orient the top surface such that the angle of incidence is substantially equal to the angle of reflectance in response to an instruction to switch the beam.

40. The method for switching an optical signal of claim 39 further comprising a detector in communication with the controller and capable of determining a signal strength of the reflected beam at the second port.

41. The method for switching an optical signal of claim 40 wherein the controller is capable of optimizing the signal strength of the reflected beam at the second port based on the communication from the detector.

42. An optical switching component comprising:

means for pivotally supporting a rotor including a top surface within a stator;

a first piezoelectric actuator connected to the stator and the rotor and configured to pivot the rotor relative to the stator when actuated.

43. The optical switching component of claim 42 further comprising an optically reflective coating formed on the top surface.

44. The optical switching component of claim 43 further comprising a seed layer between the optically reflective coating and the top surface.

45. The optical switching component of claim 44 further comprising a second piezoelectric actuator, the first and second actuators configured to cooperatively pivot the rotor relative to the stator when actuated.

46. The optical switching component of claim 45 wherein the first and second actuators connect opposite ends of the rotor to the stator.

47. The optical switching component of claim 42 including four piezoelectric actuators, two of the four piezoelectric actuators configured to pivot the rotor relative to the stator around a first axis and the other two piezoelectric actuators configured to pivot the rotor relative to the stator around a second axis.

48. The optical switching component of claim 42 wherein the rotor further includes means for limiting the range of travel of the rotor.

49. The optical switching component of claim 42 further comprising means for controlling the piezoelectric actuator.

50. The optical switching component of claim 49 wherein the means for controlling the piezoelectric actuator is configured to orient the top surface such that an angle of incidence of an emitted beam from a first port is substantially equal to an angle of reflectance of a reflected beam received by a second port in response to an instruction to switch the beam.

51. The optical switching component of claim 50 further comprising means for detecting a signal strength of the reflected beam at the second port, the means for detecting being in communication with the means for controlling.

52. The optical switching component of claim 51 wherein the means for controlling includes a feedback circuit capable of optimizing the signal strength of the reflected beam at the second port based on input from the means for detecting the signal strength.

53. A method for making an optical switching component comprising:

providing a substrate;

forming a stator by defining a cavity within the substrate;

forming a mask layer over the stator and filling the cavity;

forming an opening in the mask layer;

forming within the opening a rotor and a pivotal connection to the stator;

removing the mask layer; and

forming a piezoelectric actuator between the stator and the rotor.

54. The method of claim 53 wherein the substrate includes silicon.

55. The method of claim 53 wherein defining a cavity is performed by photolithography.

56. The method of claim 53 wherein the mask layer includes photoresist.

57. The method of claim 53 wherein forming an opening is performed by photolithography.

58. The method of claim 53 wherein removing the mask layer is performed by wet chemical etching.

59. The method of claim 53 wherein forming a piezoelectric actuator is performed before forming a rotor.

60. The method of claim 59 wherein forming a piezoelectric actuator is performed by a deposition process.

61. The method of claim 53 wherein forming a piezoelectric actuator is performed by a mechanical process.